Observations made in the upper vault, five metres under ground, show that the daily variation of temperature is insensible, and that the annual range is only a few degrees. As it is apparently water-tight, it will serve as a safe place of deposit for the standards. In the lower vault, ten metres under ground, the temperature is steady at 11° C. throughout the year. At present there is trouble from moisture. Steps are taking to overcome this difficulty; and, when they are complete, the chamber will be ready for the reception of the prototypes.

The examination of the universal comparator has been completed, and all values determined save the final errors of division of the two-metre scale. Certain auxiliary scales needed for this work were ordered, and have just been received.

Modifications are being made on the Brunner comparator to admit of comparisons of metres under water.

The report for 1882 showed that the balance for vacuum-weighings had been received; but certain defects of construction were found to exist, and it was returned to the makers to have them remedied. It was again received last autumn, and now appears to maintain a vacuum in a satisfactory manner. Its examination, and the determination of its instrumental constants, will be immediately begun.

The manufacture of the standard metres and kilograms by Johnson, Matthey, & Co., is progressing. Analyses of the alloy show it to fill all requisite conditions. Up to the present time the progress has necessarily been slow, as the important questions of alloy, refinement, and mechanical execution, had to be provided for. These matters have now been satisfactorily settled, and the delivery of the bars and ingots may be expected soon to begin.

In the report of the operations during 1882 was given an account of the copies of the *mètre des archives* and of the *kilogramme des archives*, which, on April 26, were confided to the care of the director of the bureau. Although rigorously compared, and the relation to the standards of the archives accurately determined, these were not adopted as international prototypes, but were deposited as witness-copies of these standards. The kilogram, K_{iii}, elaborately compared with the *kilogramme des archives* in 1882 and 1883, was found to be identical in value theretc; and on Oct. 3, 1883, it was formally adopted as the international prototype of the kilogram.

During the year, changes have taken place in the *personnel* of the international committee and the bureau. The Turkish member of the original committee having taken no part in its deliberations since its organization, and repeated attempts to ascertain his future intentions in the matter having failed, his place has formally been declared vacant. The vacancy as yet has not been filled. The resignation of Mr. Marek as a member of the international bureau took effect from March 1, 1883. Dr. Max Thiesen of Berlin was chosen as his successor, and is charged with matters relating to weighing.

The second volume of the *Travaux et mémoires* has appeared, and contains a number of important papers relating to comparisons and to determination of coefficients of expansion. The third volume is in press, and in great degree printed. It is expected to appear in a few months. The material for the fourth volume is in large degree prepared.

Although the comparison of the international standards has not yet begun, a number of national standards have been compared, and important physical investigations made.

Comparisons of much interest to Americans are those between the British platinum kilogram and a platinum-iridium and two brass avoirdupois pounds and the prototype kilogram, as through them our own weights are brought into more direct relation with the international standards. Also a steel metre belonging to the U. S. lake survey has been compared for length and coefficient of expansion.

Experiments with the Fizeau expansion apparatus have given a new and elaborate redetermination of the change, with temperature, of the index of refraction of atmospheric air; and the coefficients of expansion of many minerals have been determined. An elaborate redetermination of the wave-length of the sodium-ray is in progress.

Correspondence is in progress with Mexico with a view to the adoption, by that government, of the articles of the metric convention.

H. W. Blair.

A QUESTION OF EXPOSURE.

The extraordinary depressions in temperature, which occurred in the month of January in many parts of the country, have attracted an unusual amount of attention to questions of thermometry. In some instances it has been observed that the areas of excessive cold were smaller than might have been anticipated, great differences often existing where there were no

geographical or topographical reasons for them. A comparison of reliable observations, made during this period, furnishes evidence of the great importance of considering the situation and exposure of thermometers.

In the state of Ohio, there were three distinct periods of great depression during the month; and at two of these the minimum temperatures were unprecedented in the history of the state. The important fact, however, to which it seems desirable to call attention, is that the records of the U. S. signal-service observers contain no account of these extraordinary cold-waves; and we should be ignorant of their existence, if obliged to depend for information upon these records alone. This fact can be attributed, in some degree, to the small number of regular signal-service stations in the state, but in a far greater degree, in the opinion of the writer, to the situation and exposure of the thermometers of that service.

The Ohio meteorological bureau has more than twenty observing-stations, pretty well distributed over the state. The observers are generally persons of more than ordinary intelligence, and many of them have had long experience in meteorological observations. The instruments which they use are of the best pattern, being similar, in fact, to those in use by the U. S. service; and all have been compared with the standards at Washington, through the kindness of the chief signal-officer, and their errors are in most cases very small.

The U. S. signal-service has four regular stations in Ohio, situated at Toledo, Cleveland, Columbus, and Cincinnati. A station at Sandusky has recently been re-established; but reports have not been received from that station, for the month of January, by the Ohio bureau.

The first cold-wave was most severe on the 5th, 6th, and 7th. On the 5th the mean minimum for the state, from the observations of the State service, was $-16°$; and from those of the U. S. service it was $-12°$. The lowest temperature recorded by the State service was $-24.4°$; and by the U. S. service it was $-16.3°$. On the 6th the mean minimum and the lowest temperature, as recorded by the State service, were $-15.3°$ and $-24.6°$ respectively, the corresponding numbers from the records of the U. S. service being $-12.2°$ and $-20.3°$. On the 7th the difference was still more marked; the numbers being $-11.6°$ and $-19.6°$ for the State service, and $-2°$ and $-7°$ for the U. S. service.

The second great depression was of short duration, and was most severe on the 21st. On that day the mean minimum for the state, from the State service observations, was $-11.1°$, while from those of the U. S. service it was $+1.4°$. The lowest temperature recorded by the State service was $-31°$, and by the U. S. service was $-3.7°$. These minima were recorded at the same place, Columbus; the distance between the stations being slightly less than three miles. It seems difficult to understand how two stations so near to each other could furnish results differing from each other so greatly.

The question appears to be purely one of situation and exposure. The U. S. signal-service thermometers are exposed in a box or case of the usual form, attached to the north side of a stone building in the centre of the city: those of the State service are exposed in a somewhat similar shelter, but in an open space on the campus of the Ohio state university, at a considerable distance from any building. The conditions on the night of the 20th and 21st were peculiarly favorable to the production of such a result as that given above. During the 20th the temperature was not very low; and in the evening and night the sky was clear, and there was scarcely any movement in the atmosphere. The rapid fall in temperature was unaccompanied by movement of masses of air; and, as a result, the air confined in the shelter of the U. S. service thermometers was not displaced; and, being in contact with a large building which lost its heat slowly, the fall in temperature was not great. Had there been a brisk wind, or even a breeze, the result would have been different. The minimum of $-31°$, recorded by the State service, cannot be questioned; as it was supported by numerous readings from 'private' instruments, equally reliable, in the immediate vicinity and in the neighborhood of the city. At Westerville, twelve miles distant, a minimum of $-24°$ was recorded by one of the observers of the State service.

Nearly as great a difference was exhibited in the records of the 25th. For this 'dip,' which was the lowest of the three, the mean minimum for the whole state, as obtained from twenty-two stations of the State service, was $-19.8°$, while from the records of the U. S. service it was only $-5.1°$. The lowest temperature observed by the State service was $-34°$, while the lowest reported by the U. S. service was $-15.1°$.

'These comparisons lead to some conclusions which are certainly not without importance in the study of climatology. In these instances it appears that the U. S. signal-service has failed to obtain the mean lowest temperature

by from 3° to 15°, and that it has missed the minimum on different days by 5°, 8°, 13°, 19°, and 27°.

Improper exposure of thermometers will account for a part of this discrepancy; and it is well known that the chief signal-officer has already recognized the importance of this point, circulars having been distributed, some months ago, to all volunteer observers, requesting detailed information concerning the manner and method of exposure. The location of the station appears to the writer to be of even greater importance. It is unfortunate that nearly all stations of the U. S. signal-service are in large cities, and often in the most densely built and populated portion of them. Concerning temperature, at least, it is not likely that such situations will give results of great value, even with the most careful attention to exposure.

From geographical and topographical considerations, the station at Columbus is more likely to fairly represent the state of Ohio than either of the others; but the above observations show that it may fall far short of doing it. Observations taken at Cincinnati represent little more than the conditions in that city, the topography of that region being such that the city might almost be said to have a climate of its own. One of the State-service stations is at Waverly, the latitude of which is very nearly the same as that of Cincinnati. On the 21st, Waverly reported a minimum of −14°, and Cincinnati, of +7.9°; and on the 25th, Waverly reported −27.2°, and Cincinnati, +3.7°. In Cleveland and Toledo the climate is modified greatly by the presence of Lake Erie. At Wauseon, thirty miles from Toledo, the minimum is reported on the 25th as −31.7°; and at Toledo it was −9°.

There are, doubtless, excellent reasons why these stations should be where they are, and also why it is generally desirable to locate stations in large cities; but there seems to be little doubt that for temperature measurements it would be well to put stations *near* rather than *in* large cities, and at sufficient distance from them to be free from purely local conditions.

The importance of the maintenance of state weather-services is not so generally appreciated as it deserves to be. It is impossible for the U. S. service, at least at present, to increase the number of its stations to the extent that would seem desirable and necessary in order to obtain the details of climatic conditions. The organization of state services is generously encouraged by the chief signal-officer; and if they become general, and are efficient, they may be of great service to the very competent corps of government meteorologists in their investigation of general problems in climatology.

T. C. MENDENHALL.

IRON FROM NORTH CAROLINA MOUNDS.

IN the Proceedings of the American antiquarian society, vol. ii. p. 349 (1883), Professor Putnam reviews the statements of the old writers respecting metal found in the western mounds. He comes to the conclusion that Mr. Atwater's iron-bladed sword or steel-bladed dagger is to be traced to that gentleman's lively imagination.

Although Professor Putnam may be correct in his conclusion, a discovery made in North Carolina by one of the assistants in the Bureau of ethnology, during the past season, would seem to render the statement made by Atwater in regard to finding the fragment of an iron sword-blade in an Ohio mound at least probable.

In order that the reader may understand the conditions under which the articles to be mentioned were found, it is necessary to give a description of the burial-place, which I do by copying the report of the assistant.

"This is not a mound, but a burial-pit, in the form of a triangle, the two longest sides each forty-eight feet, and the base, thirty-two feet, in which the bodies and articles were deposited, and then covered over, but not raised above the natural surface. The depth of the original excavation, the lines of which could be distinctly traced, varied from two and a half to three feet. A rude sketch of this triangle, showing the relative positions of the skeletons, is given in fig. 1.

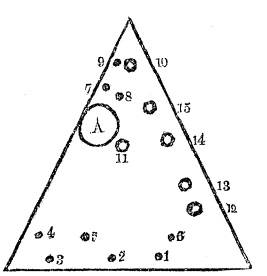

FIG. 1.

"Skeletons Nos. 1, 2, 3, 4, 5, 6, 7, 8, and 9 were lying horizontally on their backs, heads east and north-east. By No. 2 was a broken soapstone pipe; by No. 5 and also by No. 9, a small stone hatchet.

"Nos. 10, 11, 12, 13, 14, and 15 were buried in rude stone vaults built of cobblestones similar to those in fig. 2, which represents the arrangement of the bodies and vaults in a mound near by. (This mound was over a circular pit.) Nos. 10, 12, 13, and 15 were in a sitting-posture, and without any accom-